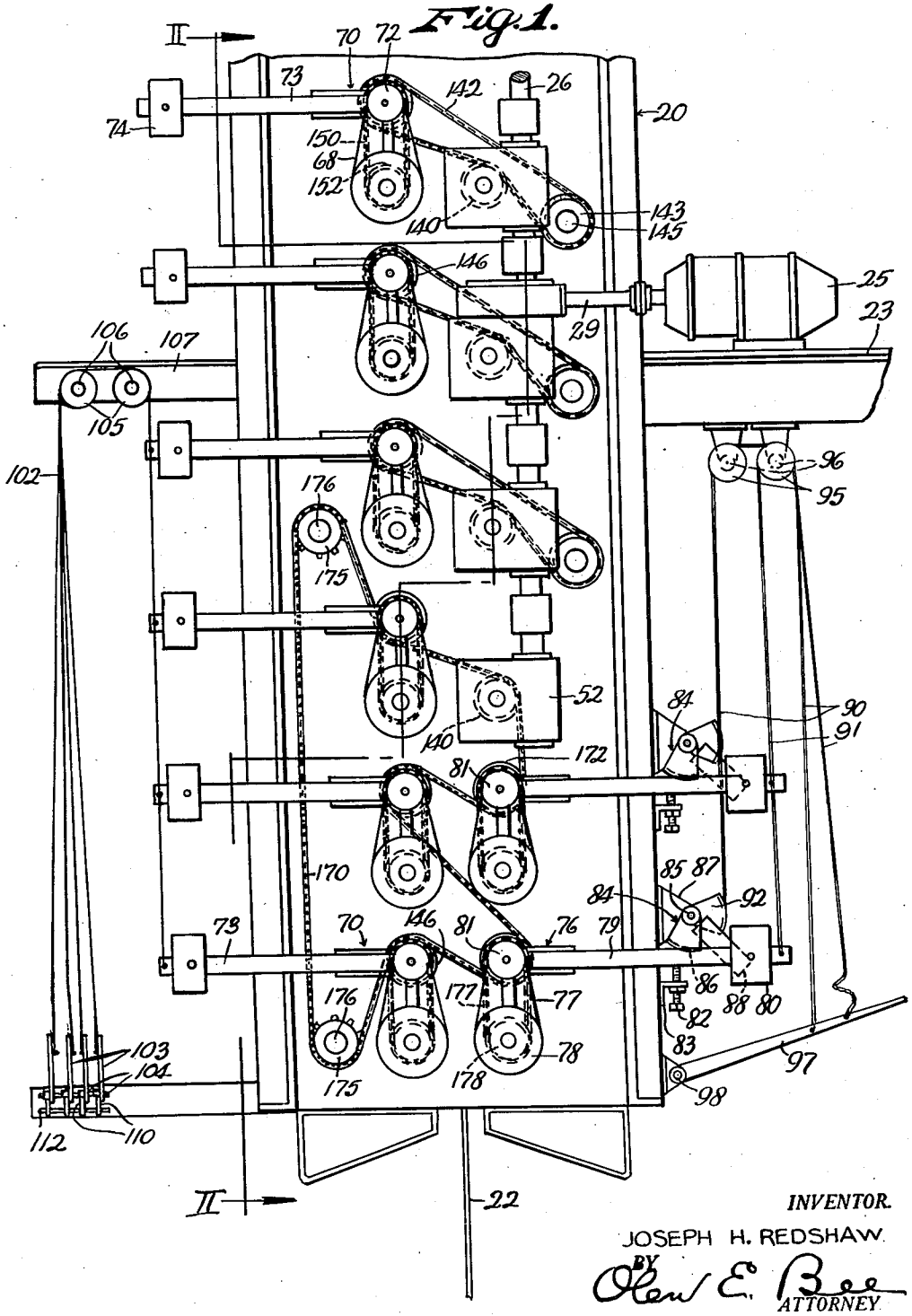
Nov. 3, 1942. J. H. REDSHAW 2,300,522

SHEET GLASS DRAWING MACHINE

Filed Jan. 16, 1940 5 Sheets-Sheet 1

Fig. 1.



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SHEET GLASS DRAWING MACHINE

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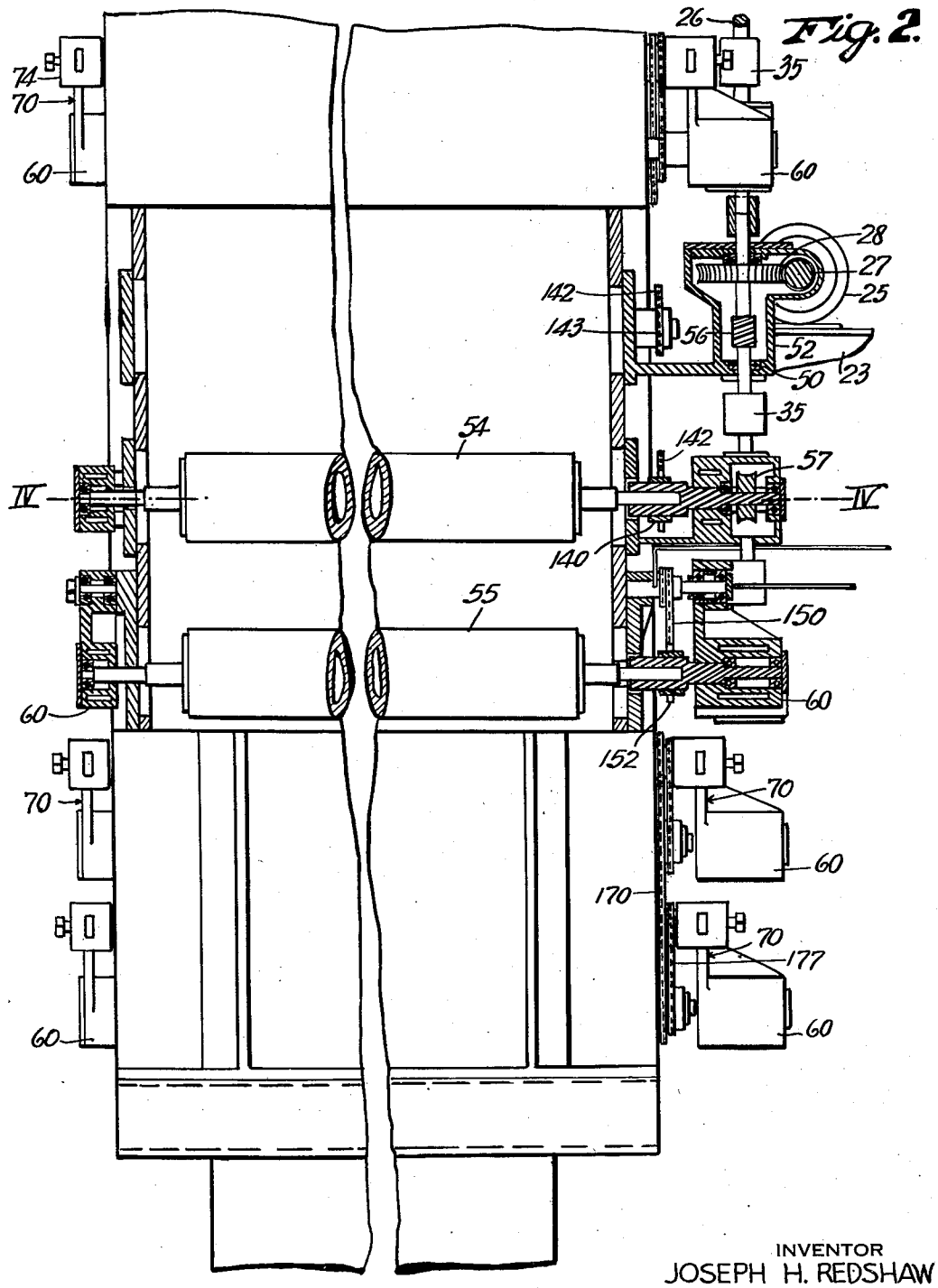
Fig. 2.



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SHEET GLASS DRAWING MACHINE

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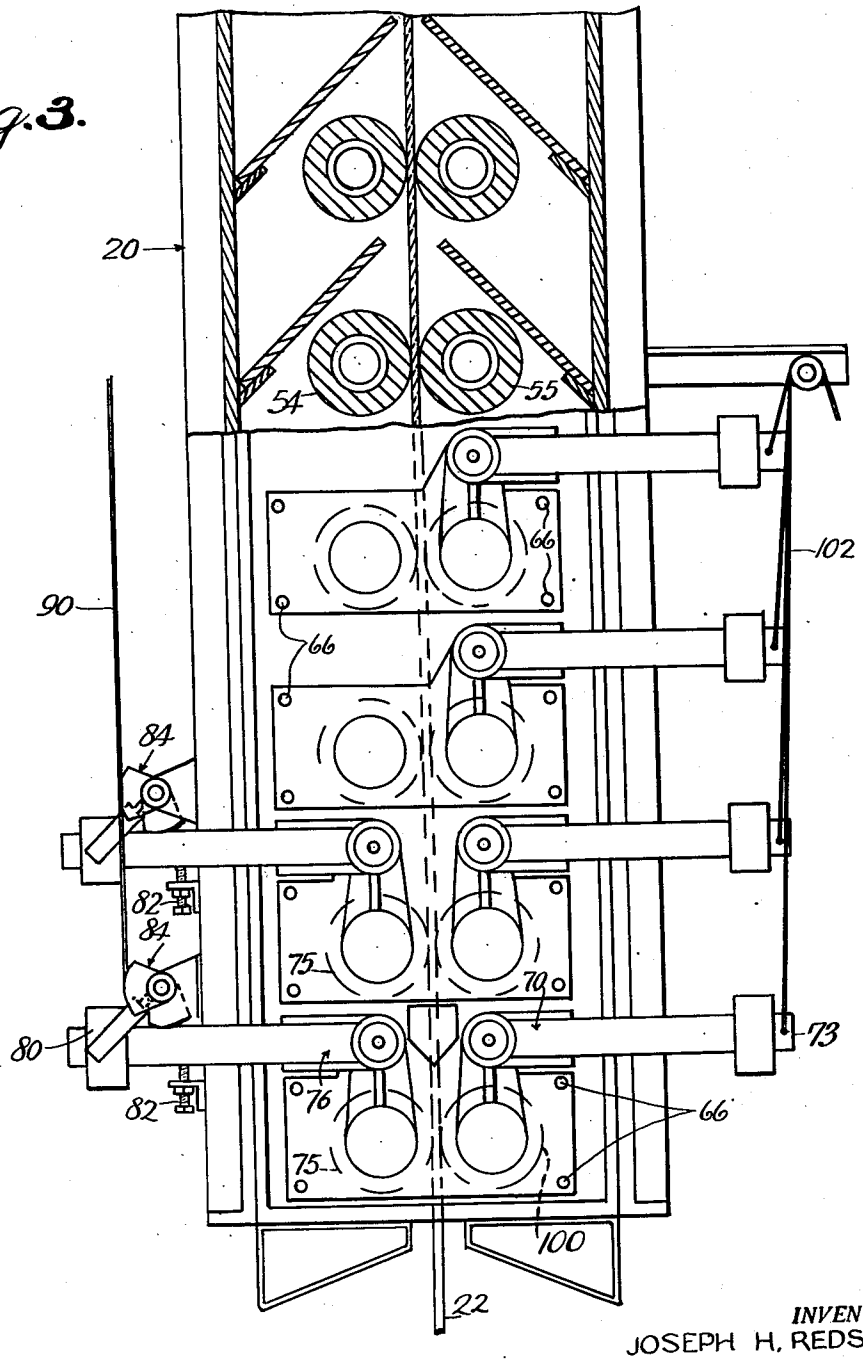
Fig. 3.



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SHEET GLASS DRAWING MACHINE

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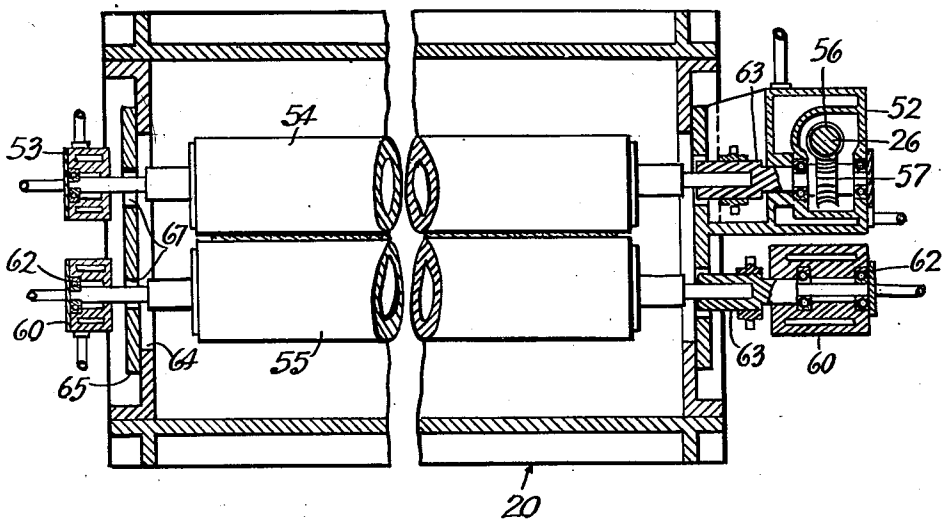
Fig. 4.



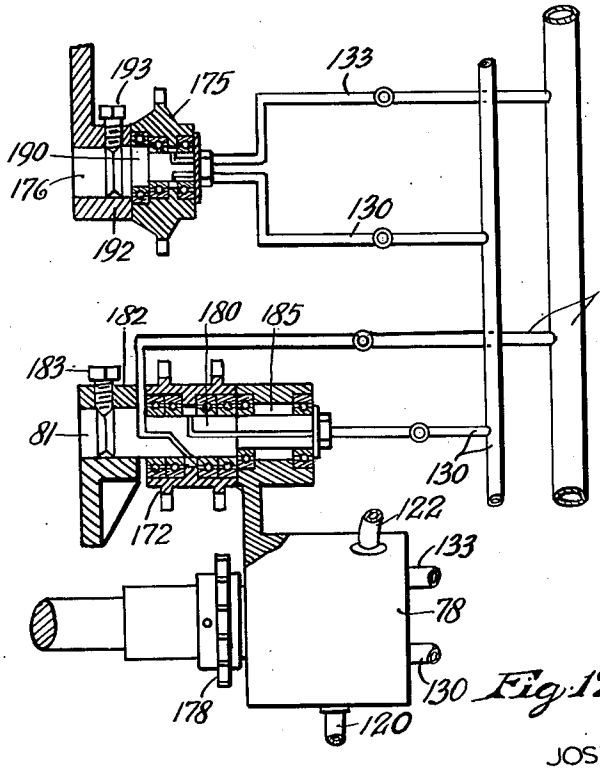
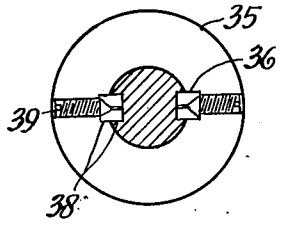


Fig. 5.

Fig. 11.



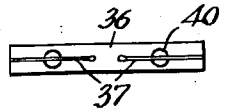


Fig. 12.

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Fig. 6.

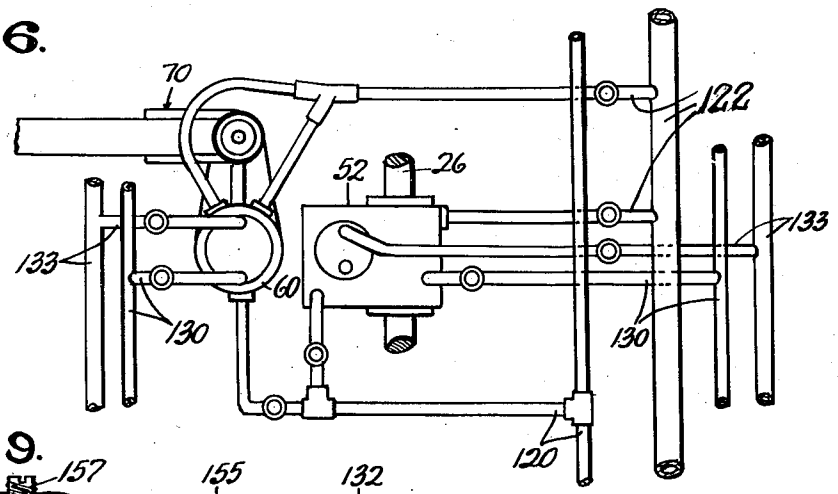


Fig. 9.

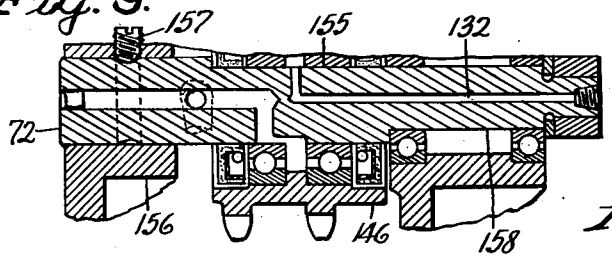


Fig. 8.

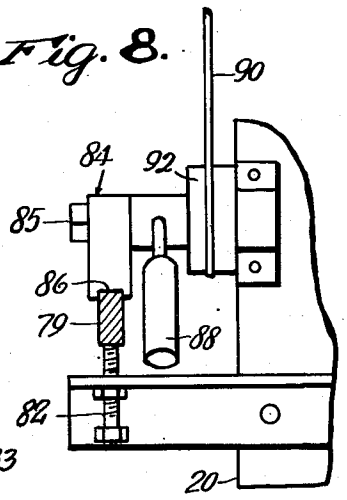
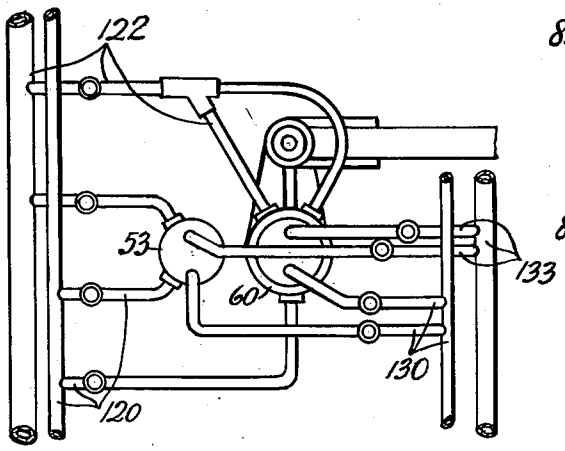


Fig. 7.



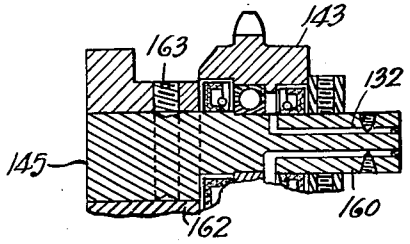


Fig. 10.

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UNITED STATES PATENT OFFICE

2,300,522

SHEET GLASS DRAWING MACHINE

Joseph H. Redshaw, Homestead, Pa., assignor to Pittsburgh Plate Glass Company, Allegheny County, Pa., a corporation of Pennsylvania

Application January 16, 1940, Serial No. 314,061

2 Claims. (Cl. 49—17)

This invention relates to glass drawing apparatus and it has particular relation to an improved assembly of elements designed to insure uniformity of drawing roll operation, compensation for tendency of heating in bearings, adjustability of rolls, together with improved operation of their driving and associated elements.

One object of the invention is to provide an improved glass drawing apparatus having bearings cooled and oiled by circulating systems to provide for the use of precision bearings in supporting drawing rolls and other elements.

Another object of the invention is to provide an improved non-play worm gearing transmission from a source of power to driven drawing rolls of the apparatus.

Another object of the invention is to provide an improved chain transmission from the directly driven drawing rolls to companion swinging or front rolls.

Another object of the invention is to provide an improved coupling structure especially adapted to conditions imposed upon the transmission shafts of glass drawing apparatus.

Another object of the invention is to provide an improved structure for swinging and aligning drawing rolls.

Heretofore, there have been proposals for gear driven rolls in glass drawing apparatus, but on account of unfavorable conditions of heat and need for precision in operation, great difficulty has been experienced in providing a type of gear which responds without unsatisfactory play and other adverse results as to roll action, such as formation of so-called roll marks, which are often visible on the surface of drawn glass. By employing precision bearings which are protected by an improved arrangement of fluid circulating and lubricating systems, as described herein, the roll marks can be obviated.

In one arrangement, according to the improved invention, lower rolls of the apparatus are swingable on bell cranks, including the lower rear rolls which are ordinarily in a stationary position during the operation of the apparatus. These lower rear rolls are adjustable with precision in aligning them with the proper plane of drawing, although they can be released and separated from companion front rolls with which they are arranged in horizontal pairs. After adjustment or swinging, they can be fastened without disturbing their precision alignment. The front rolls are all mounted upon weighted bell cranks by which proper pressure can be exerted upon sheet glass between pairs of rolls for drawing the glass. The front and rear drawing rolls are so mounted in their bearings that one or more of them can be released and removed without affecting the continuous operation of the apparatus.

In the drawings:

Fig. 1 is a fragmentary side elevation of a glass drawing apparatus; Fig. 2 is a fragmentary view partially in front elevation and partially in vertical section taken substantially along the line II—II of Fig. 1. Fig. 3 is a view partially in side elevation and partially in vertical section of the side of the glass drawing apparatus opposite that shown in Fig. 1; Fig. 4 is a fragmentary horizontal section taken substantially along the line IV—IV of Fig. 2 and including illustration of both front and rear rolls; Fig. 5 is a fragmentary diagrammatic illustration of bearing supports and fluid circulation system for operating parts of the apparatus; Figs. 6 and 7 are similar fragmentary diagrammatic side elevations illustrating the application of fluid circulation systems; Fig. 8 is a fragmentary elevation of adjusting and controlling elements for the apparatus; Figs. 9 and 10 are longitudinal fragmentary sections on a larger scale of shaft and bearing construction employed in the apparatus; Fig. 11 is a cross section on a larger scale of a coupling for a transmission shaft; and Fig. 12 is a plan of a key employed in the coupling.

In practicing the invention, a glass drawing apparatus or leer structure **20** in which sheet glass **22** is adapted to be drawn upwardly from a molten bath is provided rigidly thereon with a support **23** on which a motor **25** is anchored. The motor operates a vertical sectional shaft **26** by means of spiral or worm gears **27** and **28** connected rigidly to the drive shaft **29** of the motor and to the vertical shaft **26**, respectively. The sectional shaft **26** is connected among its sections by means of spaced couplings **35**, each of which is aligned with adjacent shaft sections, by means of split keys **36** having oppositely extending split portions **37** formed longitudinally therein and fitting in keyways **38** formed in the coupling and shaft. Suitable screws **39** threaded through the body of each coupling engage in conical recesses **40** formed in the keys along the split portions thereof for spreading the latter and tightening the couplings on the shaft sections to take up any play that might exist after they have been assembled and after the apparatus has been heated preparatory to the beginning of the drawing operations.

Suitable bearings **50** of precision type carried

in a series of spaced bearing jackets 52 that are rigid with the leer structure support the shaft in its vertical position. Each bearing jacket 52 cooperates with an oppositely disposed bearing jacket 53 (Fig. 4) rigidly carried on the opposite sides of the leer for the purpose of rotatably supporting one roll 54 of a pair of drawing rolls 54 and 55. The other roll 55 of this pair is provided with oppositely disposed bearing jackets 60 in which it is rotatably mounted in its bearings 62.

A number of pairs of these rolls are spaced vertically in the leer and each roll 54 is driven from the vertical shaft 26 by means of intermeshing spiral or worm gears 56 and 57 connected rigidly to the shaft and roll, respectively. One end of each roll 54 and 55 is provided with a separable section 63 slidable, and non-rotatably carried coaxially, with respect to its roll, but rotatable with such roll, and from which the latter can be disconnected and removed through an opening 64 formed in the wall of the leer. Plates 65 normally bolted, as indicated at 66, to the leer serve as shields for the bearing jackets 53 and 62 to protect them from inside heat of the leer. Openings 67 in the plate are of such size as to permit proper play or adjustability of the rolls while they are being aligned and during the operation of the apparatus.

Each jacket 60 is suspended rigidly upon an upright swinging arm 68 of a bell crank 70 that is rotatably mounted on a stud shaft 72 carried rigidly upon the leer and that also has a substantially horizontal arm 73 upon which an adjustable weight 74 is slidable.

Each of the two lower rolls 75 is also carried by a bell crank 76, which has an upright arm 77 in which the roll 75 is suspended in a bearing jacket 78. A substantially horizontal arm 79 of the bell crank is provided with an adjustable slidable weight 80 thereon. Each roll 75 is thus swingable although normally aligned vertically with the rolls 54. These bell cranks are mounted upon stud shafts 81 carried rigidly in the leer structure and the position of each of the two lower rolls 75 can be established with precision by means of a stop bolt 82 adjustably threaded through a bracket 83 that is rigid on the leer. The lower side of the arm 79 rests upon the end of the bolt 82 and a clamping cam lever 84 (Figs. 1 and 8) having a cam face 86 is rotatably mounted, as indicated at 85, on a bearing bracket 87 that is carried on the leer above each arm 79. This lever cooperates with the bolt 82 to lock the arm in a predetermined position by wedging the cam face against the upper portion of the arm. A weighted lever arm 88 extends laterally from the lever 84 and constantly exerts force pressing, or tending to press, the cam face into locking relation with the arm 79.

Cables 90 and 91 are connected at their inner ends to arms 92 of the cam levers and to arms 79, respectively, from which they are trained over pulleys 95 rotatably carried, as indicated at 96, upon the motor support 23 and the outer ends of these cables are connected to a manually operable bar 97 having a pivotal connection 98 with the leer. One cable 91 is substantially longer than the other cable 90 for the purpose of maintaining one of them taut and the other slack, as shown in Fig. 1, and thus, the cables are operable by the bar 97 for first lifting the outer ends of the lever arms 92 and then lifting the outer ends of the arms 79 in effecting the adjustment of the two lower rolls 75.

A plurality of lower rolls 100 corresponding to the rolls 55 and in substantially vertical alignment therewith are also movable by means of cables 102 having their inner ends connected to the outer ends of the lever arms 73 and outer cable ends are connected to manually operable bars 103 pivoted, as indicated at 104, upon the leer. Intermediate portions of cables 102 are trained over pulleys 105 carried rotatably, as indicated at 106, upon an upper frame member 107 of the leer structure. Suitable latches 110 pivoted upon a rod 112 that is mounted upon the leer frame are engageable with the bars 103 to hold them in lowered position after they have been operated to pivot the roll suspending lever arms 68 in such manner as to move the lower rolls outwardly. Since the mountings of the lower rolls 100 are substantially the same as those for the upper rolls 55, the same reference characters are employed for the parts associated therewith, such as the bell cranks 70 and bearing jackets 60. It should be noted that each of the rolls has its opposite ends outside the leer casing wall in order that the supporting bearings may be as far from the heat inside the leer as practical operation will permit.

Referring to Figs. 5, 6 and 7, each jacket 52, 53, 60 and 78 which contains fluid circulation chambers surrounding the bearings for the vertical transmission shaft and for the various rolls communicates with flexible inlet conduits 120 through which cooling fluid, such as water, can be circulated and then exhausted through flexible fluid conveying outlet conduits 122. Likewise each bearing enclosed in fluid tight relation in the jacket communicates with flexible oil conveying inlet conduits 130 through which oil is circulated through ducts 132 to the bearings and then exhausted therefrom through oil conveying outlet conduits 133.

In transmitting power from the vertical shaft 26 both the stationary and swinging rolls are provided with sprockets, one of which designated 140 is rigidly carried by each roll 54 and engages a sprocket chain 142 that has one of its reaches trained thereover. An idler sprocket 143 rotatably carried upon a stud shaft 145 rigid in the leer receives the chain at one extremity of its path and a double sprocket 146 receives the chain at the other extremity of the path. The double sprocket is rotatable upon the stud shaft 72 coaxially with respect to the axis of swinging of the bell crank 70. Another chain 150 is trained over the double sprocket 146 adjacent the chain 142 and also over a sprocket 152 carried rigidly upon an end portion of each swinging roll 55. In this arrangement the swinging rolls 55 can be rotated at a constant speed corresponding to the speed of the rolls 54, while at the same time permitting the swinging thereof.

As shown in Fig. 9, each stud shaft 72 has an eccentric section 155 upon which the double sprocket 146 is rotatably mounted and the shaft can be rotatably adjusted in its supporting socket 156 on the leer by means of a conventional set screw or bolt 157 screw threaded through the wall of the socket. The chain 150 can be tightened without changing the relative positions of each roll 55 and its supporting shaft 72 with regard to the distance between their axes because the bell crank 70 is mounted upon a non-eccentric section 158 of the stud shaft. Each stud shaft 145 (Fig. 10) also has an eccentric section 160 upon which the sprocket 143 is mounted and the shaft can be rotatably adjusted in its socket 162

on the leer by means of a suitable set screw or bolt 163 screw threaded through the wall of the socket. Thus the chain 142 can be tightened without changing the relative positions of the sprockets 146 and 152 and independently of the adjustment effected by means of the eccentric section 155 of the stud shaft 72.

Since the two lower rolls 75, as well as the lower rolls 100, are mounted upon swinging adjustable bell cranks 76, and 70, respectively, there is provided therefor another form of chain drive 170 which is trained over the lower stationary roll sprocket 140 from which it is driven and about a double sprocket 172 (Fig. 5) carried rigidly upon the stud shaft 81 for each lower bell crank 76. Additional sprockets 175 carried rotatably upon spaced eccentric stud shafts 176 also receive the chain 170 which is likewise trained about the double sprockets 146 of the three lower bell crank supports 72.

In this portion of the apparatus, a sprocket chain 177 is trained about the double sprocket 172 and about a roll driving sprocket 178 rigidly carried upon the end of each lower roll 75 in the same manner as the chain 150 is associated with each roll 55.

Each stud shaft 81 has an eccentric section 180 upon which the double sprocket 172 is mounted and the shaft can be rotatably adjusted in its supporting socket 182 on the leer by means of a conventional set screw or bolt 183 screw threaded through the wall of the socket. The chain 179 can be tightened without changing the relative position of each roll 75 and its supporting stud shaft 81 because the bell crank 76 is mounted upon a non-eccentric section 185 of the stud shaft. Each stud shaft 176 (Fig. 5) has an eccentric section 190 upon which the sprocket 175 is mounted and the shaft can be rotatably adjusted in its socket 192 on the leer by means of a suitable set screw or bolt 193 screw threaded through the wall of the socket. Thus the chain 170 can be tightened without changing the relative positions of the sprockets 172, 178 or 146, 152 independently of the adjustment effected by means of the eccentric sections 180, 155 of the stud shafts 81, 72.

From the foregoing description, it will be apparent that the various features described cooperate to produce an extremely smoothly running glass drawing apparatus, in which the vertical shaft 26 has direct driving contact with the several stationary rolls in such manner that there can be no appreciable play during the operation. There can, therefore, be no trembling or vibration of the drawing rolls. Such play is obviated by the use of worm gears, as described. Likewise, each of the upper pair of rolls has a chain drive from each stationary roll to its companion swinging roll 55, and the latter roll of each pair can be maintained in its proper driving relation and without danger of play occurring by manipulating the eccentric shafts 72 and 145 to insure constant tautness in the chain drive.

In order to facilitate the precision alignment of the lower rolls which first receive the glass sheet from the molten bath, these lower rolls of each pair are mounted upon bell cranks on opposite sides of the plane of drawing and a common sprocket chain provides for maintaining the operation of these lower rolls in proper relation to the operation of the upper rolls. Likewise, by including the continuous flow of lubricating fluid to the end bearing of the rolls and, at the same time, providing for continuous flow of cooling fluid, such as water, to the jackets surrounding the bearings, an extremely accurate and uniformly operating glass drawing unit is insured.

Although considerable variation in structure of the several parts of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various changes can be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In an apparatus for drawing sheet glass from a molten bath substantially along a predetermined vertical plane and including an upright supporting leer casing, a series of pairs of drawing rolls normally arranged successively in substantial alinement in the leer casing, at least one pair of the rolls including a normally stationary roll and a movable roll, a bell crank having an upright arm supporting each end of said movable roll for lateral movement thereof, each bell crank having a lateral arm, a supporting bearing shaft carrying each bell crank on the casing at the junction of the arms, and having a double sprocket rotatable thereon, an idler sprocket mounted on said casing and having a chain trained therefrom to the double sprocket, said stationary roll having a sprocket engaging said chain between the double sprocket and the idler sprocket, a second chain trained about said double sprocket, an additional sprocket connecting said second chain in driving relation to said movable roll to swing with said upright arm, and a vertical driven shaft rotatably mounted upon the leer casing, said stationary roll and driven shaft having meshing worm gears thereon for driving the stationary roll.

2. In an apparatus for drawing sheet glass from a molten bath substantially along a predetermined vertical plane and including an upright supporting leer casing, a series of pairs of drawing rolls normally arranged successively in substantial alinement in the leer casing, at least one pair of the rolls including a normally stationary roll and a movable roll, a bell crank having an upright arm supporting each end of said movable roll for lateral movement thereof, each bell crank having a lateral arm, a supporting bearing shaft carrying each bell crank on the casing at the junction of the arms, said bearing shaft having an eccentric portion and being rotatably adjustable in said casing, a double sprocket rotatable on the eccentric portion of said bearing shaft, an idler sprocket eccentrically adjustable on said casing and having a chain trained therefrom to the double sprocket, said stationary roll having a sprocket engaging said chain between the double sprocket and the idler sprocket, a second chain trained about said double sprocket, an additional sprocket connecting said second chain in driving relation to said movable roll to swing with said upright arm, and a vertical driven shaft rotatably mounted upon the leer casing, said stationary roll and driven shaft having intermeshing worm gears thereon for driving the stationary roll.

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